Small Business Innovation Research/Small Business Tech Transfer

Multi-Fidelity Surrogate Modeling for Computational and Experimental Data Consolidation, Phase I

Completed Technology Project (2018 - 2019)

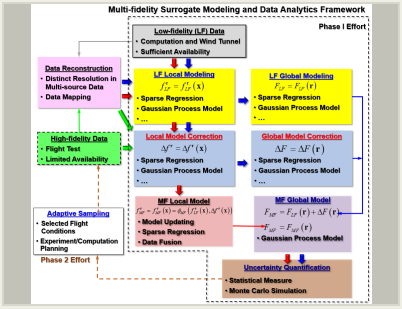
Project Introduction

The goal of the project is to develop a mathematically rigorous, multi-fidelity surrogate modeling (MFSM) methodology to consolidate experimental and computational aerodynamic data into integrated databases with quantifiable uncertainty. The salient aspects of the proposed solution are: (1) a hierarchical MFSM formulation to encapsulate local response surface modeling, model adaptation/fusion, interpolation/blending, and uncertainty quantification onto a holistic platform; (2) a suite of surrogate modeling techniques to capture the local aerodynamic behavior around the operating points; (3) formal adaptation/fusion techniques to bridge the gap of fidelity and merge data from multiple sources; (4) a global data interpolation strategy to stitch the local models for accurate prediction in a broad flight parameter space; and (5) a modular software framework to automate the process and facilitate integration with NASA's data analysis workflow. In Phase I, all key components will be designed and developed. Feasibility will be demonstrated via case studies of NASA interest, in which computational, wind tunnel, and flight test data will be analyzed and merged using the developed software and its performance (e.g., accuracy, reliability, data compatibility, and integrability) will be assessed. The Phase II effort will focus on capability extension, algorithm optimization, technology integration/insertion, and extensive validation and demonstration.

Anticipated Benefits

The proposed tool will (1) determine *in-situ* interactions between flight loads and states; (2) identify primary contributions to load generation; (3) reconcile differences in flight tests; and (4) combine data from various sources for consistent representation. The tool will enhance computational modeling, data analytics, and decision-making capabilities, benefiting NASA projects like High Speed Aeroservoelasticity, and Multi-Use Technology Testbed.

Other markets include aerospace, aircraft, and watercraft engineering utilizing data analysis and test, i.e., USAF, MDA, Navy, aircraft, and automotive industry. The project would contribute by enabling accurate, rapid, data analysis, modeling, and prediction, for (1) simulations for concept evaluation, and optimized design; (2) on-site system diagnostics, (3) parameter sensitivity and correlation analysis; and (4) optimizing test procedures.



Multi-Fidelity Surrogate Modeling for Computational and Experimental Data Consolidation, Phase I

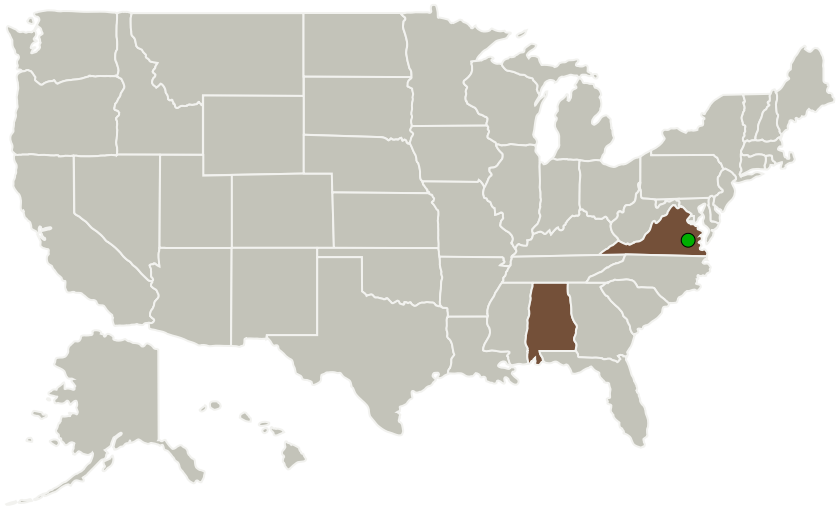
Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

Multi-Fidelity Surrogate Modeling for Computational and Experimental Data Consolidation, Phase I

Completed Technology Project (2018 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Alabama	Virginia

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137865)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

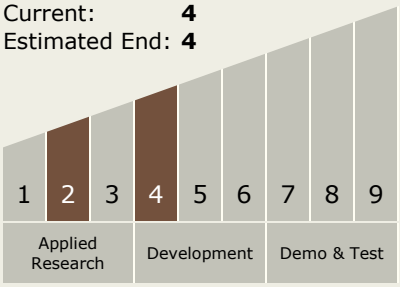
Carlos Torrez

Principal Investigator:

Andrew Kaminsky

Technology Maturity (TRL)

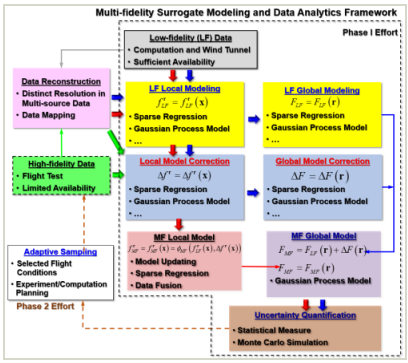
Start: **2**
Current: **4**
Estimated End: **4**



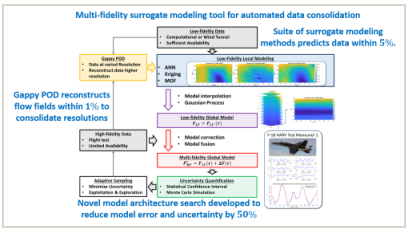
Multi-Fidelity Surrogate Modeling for Computational and Experimental Data Consolidation, Phase I

Completed Technology Project (2018 - 2019)

Images



Briefing Chart Image
Multi-Fidelity Surrogate Modeling for Computational and Experimental Data Consolidation, Phase I
(https://techport.nasa.gov/image/133989)



Final Summary Chart Image
Multi-Fidelity Surrogate Modeling for Computational and Experimental Data Consolidation, Phase I
(https://techport.nasa.gov/image/131586)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.3 Aeroelasticity

Target Destination

Earth